



UIC 0702

1 OF 2

CO10789-00420

204-079

205a(1) UIC - CO10789-00420 - PERMIT, NON
MCELMO DOME FIELD WOODS # 3 (W'ND-1)

Fldr #: 9047

204

PRIV

FACT SHEET

Application for Underground Injection Control Permit

For a Class I Well

This fact sheet was developed partially from information supplied by Shell Western E & P, Inc. in the permit application supplied. Other documents used in developing this fact sheet are given on page 11, "REFERENCE DOCUMENTS."

The fact sheet gives the derivation of the site specific permit conditions (Part II of the permit) and reasons for them. The general permit conditions for which all contents are mandatory and not subject to site specific differences (based on 40 CFR Parts 124, 144, 146, and 147), are not included in the following discussion.

Date: November 21, 1985
EPA I.D. No. COS12ME-0104

1. SYNOPSIS OF APPLICATION

a. Name and Address of Applicant

Shell Western E & P, Incorporated
Post Office Box 991
Houston, Texas 77001

b. Name and Address of Facility

Cortez Production Unit
P.O. Box 1120
Cortez, Colorado 81321

c. Well Name and Location:

Woods No. 3 (MWD-1)
160 ft. from North Line, 600 ft. from East Line
NE 1/4, NE 1/4, SE 1/4, Section 16 Township 37N, Range 17W
Montezuma County, Colorado

d. Description of Applicant's Operation

Shell Western E & P, Incorporated (Shell), a subsidiary of Shell Oil Company, is involved in the extraction of oil and gas from subsurface reservoirs. Shell has found that by using Carbon Dioxide (CO₂) as an enhanced oil recovery agent, the production of oil once thought unrecoverable is possible. Hence, Shell is developing CO₂ source fields.

This injection well will be used for disposal of water generated in the production of CO₂ from wells to the Moqui facility. At start-up, four wells will be producing CO₂, but ultimately, eight to ten wells total may be producing CO₂ to this facility. The CO₂ production will be from the Leadville Limestone. The water produced from the wells after CO₂ separation will be collected and injected into the Leadville Limestone (Ls.) and Ouray Formation (Fm.), via the Woods No. 3 water injection well.

e. Background

EPA's Underground Injection Control (UIC) program received an administratively complete application on July 23, 1985, and notified the applicant on August 22, 1985, that a complete application had been made for the construction of a Class I non-hazardous waste injection well to be operated by Shell Western E & P, Inc. of Houston, Texas. This fact sheet and the draft permit pertain to the proposed well known as Woods No. 3 (MWD-1).

f. Special Conditions

This permitting action, under the Safe Drinking Water Act, applies only to the issuance of the UIC permit for Woods No. 3 (MWD-1) brine disposal well located in the NE 1/4, NE 1/4, SE 1/4, Section 16, Township 37N, Range 17W, McElmo Dome Field, Montezuma County, Colorado. Issuance or denial of this permit does not preempt any other Federal, State, or local permitting requirements.

40 CFR Part 144.36 requires that permits for Class I wells shall be effective for a fixed term not to exceed 10 years. This draft permit is due to expire in 10 years from the effective date, should it be issued as drafted or with modifications.

The draft permit contains a condition which states that EPA may, for cause, modify, revoke, and reissue, or terminate the permit in accordance with Federal regulations. Thus, EPA may modify, revoke, and reissue, or terminate the permit in response to revisions or amendments in the Safe Drinking Water Act (SDWA).

Additionally, the draft permit requires the permittee to conduct a mechanical integrity test prior to the full operation of this facility in order to demonstrate that Underground Sources of Drinking Water (USDW's) are being protected.

g. Injection Zone Hydrogeology

The injection zone is in the Leadville Ls. of Mississippian age and the Devonian age Ouray Fm. The Leadville Ls. occurs at a depth of 7,776 feet from surface and is 270 feet thick. The Ouray Fm. is at 8,046 feet from surface and is not penetrated through the entire formation (TD is 8145 ft. PBD is 8,102 ft.). Lithology of the Leadville Ls. is limestone, often oolitic and fossiliferous, changing to dolomite in the lower half of the unit. The Ouray Fm. is limestone and dolomite with occasional streaks of gray-green waxy shale.

Both formations are perforated in the interval of 7,836-8,062 feet from surface. Hydrogeologic parameters for this interval are:

Porosity: 11.2%
Permeability: 0.6 md
Fluid pressure = 2,500 psi.
Fracture pressure = 4,330 psi.
Bottom hole pressure = 3,344 psi at 2 BPM
Bottom Hole temperature = 160° F
Total Dissolved Solids (TDS) ranges from 3,000 - 100,000 ppm, depending on the location of the gas water interface ("Free water" is the higher TDS value).

h. Confining Zone Hydrogeology

The overlying Molas Formation has been described as the confining zone for this well. The Molas Fm. is a Pennsylvanian age redbed, consisting of interbedded red siltstone and sandstone, light colored limestone and varicolored shales. This formation was evaluated by electric logs to estimate its petrophysical properties. These logs included: a Borehole Compensated Sonic Log, a Compensated Neutron Log, a Formation Density Log, a Dual Laterolog and microlaterolog-microlog. The interpretation of these logs showed the formation to be 124 feet thick. The shales and siltstones of the Molas Fm. have apparent log porosity but are impermeable. The limestone intervals are tight, with porosity less than two percent.

Other shale formations between the injection zone and the lowest most possible USDW include the Cutler Formation, the Moenkopi Formation and the Chinle Formation, these three units are considered redbeds and have low permeabilities. The Chinle Fm. is 904' thick, the Moenkopi Fm. is 68' thick and the Cutler Fm. is 1,712' thick.

i. Local Groundwater Utilization

Except for this facility, there are no known wells penetrating the injection zone within the area of review. The deepest water well in Township 57N, Range 17W is 680 feet. Water production is from the Dakota Sandstone and possibly the Salt Wash Member, of the Morrison Formation. Other potential fresh water bearing units were identified, in the report titled Mineral and Water Resources of Colorado in Water Resources, by J.W. Odell, D.L. Coffin, and R.H. Langford (1964), as "... in order of importance are, the Dakota Sandstone, of Cretaceous age. The Entrada and Junction Creek Sandstone and the Salt Wash Member of the Morrison Formation, all of Jurassic age; and the Wingate Sandstone of Triassic age. Older rocks generally yield no water or water that is too highly mineralized for ordinary uses."[sic].

The report titled Atlas of Ground Water Quality in Colorado by F.N. Repplier, E.C. Healy, D.B. Collins and P.A. Longmire (1981), shows ground water production from the Cretaceous age Dakota Sandstone with water quality of 1,410 ppm. TDS. This water well is over 10 miles to the north of the disposal well. There is also water production from the Jurassic age Morrison Formation of 1,450 ppm TDS water, 10 miles to the southwest. All of the water bearing and potentially water bearing formations are hydrogeologically isolated from the injection zone by the identified confining layer, cement in the wellbore and the other 2,000 feet of redbeds and shale.

John Romero, Supervisory Water Resource Engineer, for the Colorado Department of Natural Resources, researched the water resources of the subsurface around the McElmo Dome Unit.

"Known or suspected aquifers in the area are: Surficial Deposits, the Dakota and Burro Canyon Formations, Salt Wash member of the Morrison Formation, the Junction Creek and Entrada Sandstone and (possibly) the Chinle Formation. The underlying Cutler and Rico Formations have aquifer potential but definitive data are lacking."

2. PHYSICAL SETTING

a. Structural Geology

The Woods No. 3 well is located on the eastern flank of the Colorado Plateau physiographic province. This province is characterized by thick sequences of sediments which have been structurally stable since Precambrian time. Major geologic events, in more recent time (Tertiary), include the intrusion of laccolithic stocks such as the Sleeping Ute Mountain. This volcanic/plutonic rock body, provided the heat source that caused the Leadville Ls. to alter and give off CO₂ gas, which accumulated in economic quantities in the McElmo Dome area.

b. Stratigraphy

The Colorado Plateau is characterized by thick sedimentary sequences and a tectonically stable environment since Precambrian time. The stratigraphic units, penetrated by the Woods No. 3 well, are listed in Table 1.

c. Hydrogeology

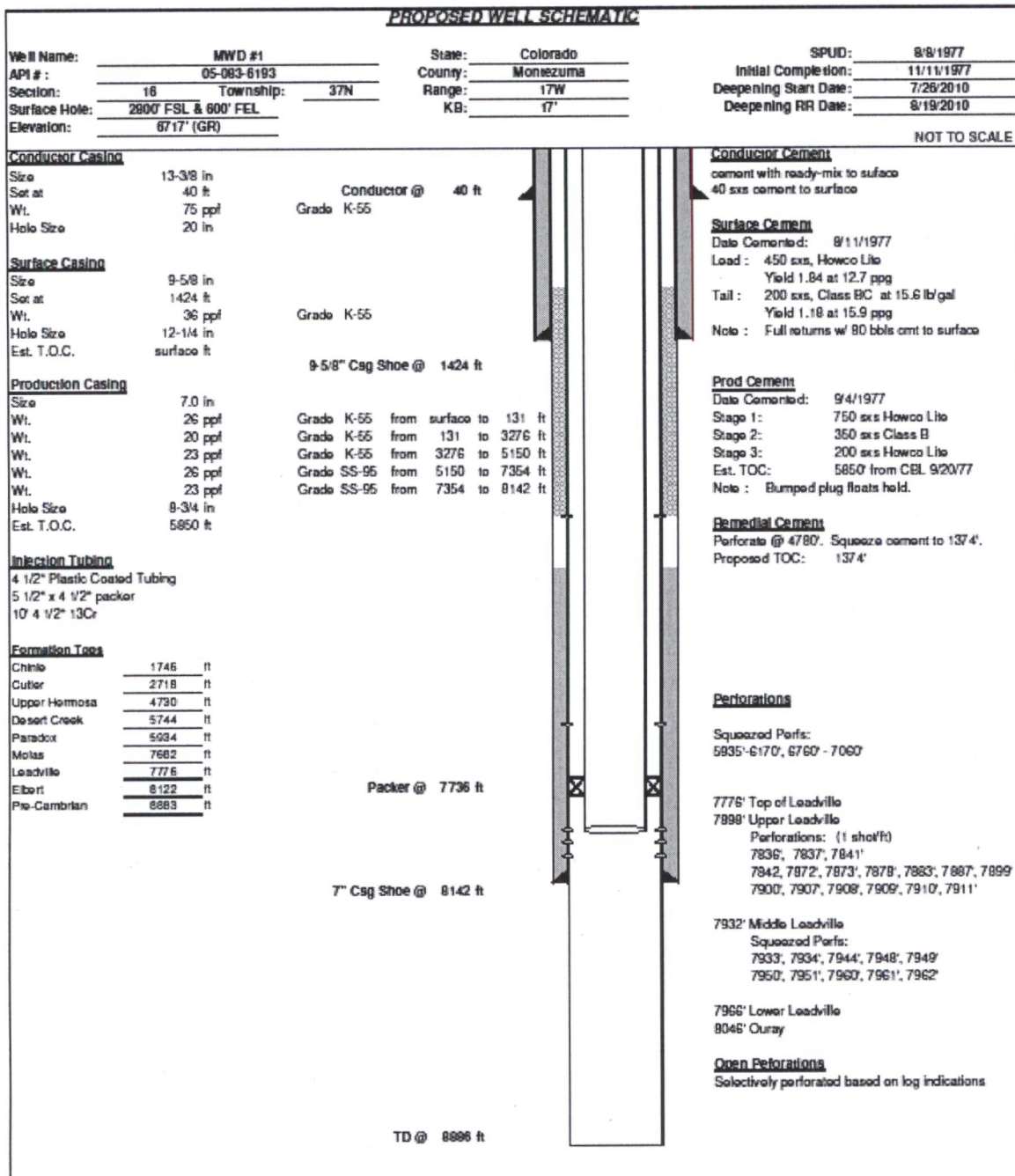
Hydrogeologic horizons have been identified (in three reports referenced or included in the Administrative Record) to be: Surficial Deposits, which are normally less than 20 feet thick except along valley bottoms. No water wells utilize these types of deposits in the area, (Romero, 1985). "Dakota Sandstone, Burro Canyon, and Salt Wash Member strata are known aquifers in other areas and probably have water yielding properties in Section 16. The Junction Creek and Entrada Sandstones are known aquifers and a well about three miles to the east in Section 13 probably taps one or both of these sandstones. Geologic units below the Entrada and above the Hermosa (Navajo, Wingate, Chinle) yield small quantities of water to wells in other areas, but nothing is known of their water yielding potential in the vicinity of the McElmo Dome Unit application", (Romero, 1985).

The Leadville/Ouray formation water quality is quite variable. The TDS concentration ranges from 3,000 ppm to over 100,000 ppm depending where the water sample is taken. The lower TDS values are drawn from above the gas-water interface, where the water is in vapor form and drops out as condensation, with the change in pressure and temperature when the gas is produced. The higher TDS concentrations come from below the gas-water interface where "free water" is occurring. The injection zone, in the permit application, was shown to have a TDS concentration of 35,350 ppm. This sample was from another injection well within the area. A full analysis of the fluid in the injection zone will be performed prior to the commencement of injection; however, it is anticipated that the classification of a USDW does not apply. The injected fluid has a TDS concentration of 3,100 ppm, the porosity of the zone is 11.2% with a permeability of 0.6 millidarcy (md).

3. WELL CONSTRUCTION

The construction of the Shell Woods No. 3 (WMD-1) well, started August 8, 1977, and total depth (TD) was reached September 2, 1977. The well was initially drilled as a CO₂ exploratory well but the well was found to be uneconomical for CO₂ production, and was subsequently shut-in with a Baker packer and KCl water.

KINDER MORGAN



APPENDIX A CONSTRUCTION PROCEDURE

The Woods No. 3 (MWD-1) shall be constructed, as follows:

Elevation: 6,717 ft. (GR)

Conductor Casing:

13-3/8 inch casing, casing set at 0 – 40 ft., 20 inch hole, cement from 0 – 40 ft. (40 sxs. ready mix cement)

Surface Casing:

9-5/8 inch casing, casing set at 0 – 1,424 ft., 12-1/4 inch hole, cement from 0 – 1,424 ft. (450 sxs. Howco Lite and 200 sxs. Class B and C cement)

Production Casing:

Remedial Action: Perforate the well casing at 4,780 ft. Squeeze cement through the perforation in the 7 inch casing to place cement behind pipe between the interval 1,374 ft. – 4,780 ft.

7 inch casing, casing set at 0 – 8,142 ft., 8-3/4 inch hole, cement from 1,374 ft. – 4,780 ft. and 5,850 ft. – 8,142 ft. (750 sxs. Howco Lite; 350 sxs. Class B; and 200 sxs. Howco Lite)

Top of Cement (TOC): 1,374 ft.

Total Depth: 8,886 ft. (Based upon driller interpretation this well may be drilled to 8,900 ft.)

Plug Back Total Depth: none

Perforations: 5,935 ft. – 6,170 ft. ; 6,760 ft. – 7,060 ft. (squeezed perforations)

Leadville/Ouray Perforations: 7,836 ft. – 7,911 ft. (open perforations)

7,933 ft. – 7,962 ft. (squeezed)

Devonian (Elbert)/Cambrian: 8,142 ft. – 8,886 ft. (open hole)

Tubing: 4-1/2 inch plastic coated tubing or similar type, set at 7,782 ft. or within 100 ft. of the top open perforation

Packer: 5 1/2 inch x 4 1/2 inch or similar type, set at 7,736 ft. or within 100 ft. of the top open perforation

All of the depths provided above are approximate measurements. Following the receipt of approval on the Final Permit and the completion of construction activities the operator shall submit a Well Completion Form and revised well rework construction diagram which shall be subject to EPA's approval.

APPENDIX E OPERATING REQUIREMENTS

MAXIMUM ALLOWABLE INJECTION PRESSURE:

Maximum Allowable Injection Pressure (MAIP) as measured at the surface shall not exceed the pressure(s) listed below:

Well Name: Woods No. 3 (MWD-1)

Maximum Allowed Injection Pressure: 1,000 psi

INJECTION ZONE(S):

Injection is permitted only within the approved injection interval listed below. Injection perforations may be altered provided they remain within the approved injection interval and the Permittee provides notice to the Director in accordance with Part II, Section A.4. Specific injection perforations can be found in APPENDIX A.

Woods No. 3 (MWD-1)

FORMATION NAME	APPROVED INJECTION INTERVAL (ft)
Leadville	7,776 – 8,046
Ouray	8,046 – 8,122
Undifferentiated Devonian and Cambrian	8,122 – 8,900

FORMATION NAME	PERFORATED INTERVAL (ft)
Leadville-Ouray	7,836 – 7,951
	8,012 – 8,062
Undifferentiated Devonian and Cambrian	8,145 – 8,900 (open hole)

ANNULUS PRESSURE:

The annulus pressure shall be maintained at/or below twenty-five (25) psi gauge as measured at the wellhead. If this pressure cannot be maintained at/or below twenty-five (25) psi, the Permittee shall follow the procedures listed under Part II, Section D.5 of this permit to reduce annulus pressure.

MAXIMUM INJECTION VOLUME:

There is no limitation on the number of barrels per day (bbls/day) of water that shall be injected into this well, provided further that in no case shall injection pressure exceed the limit shown above.